CLAIMS

We claim:

1. A microelectronic power regulator for regulating power to a microprocessor, comprising:

a first power regulator; and

a sense circuit configured to sense a rate of change of power distributed to the microprocessor, wherein

the sense circuit is configured to send a signal to the first power regulator, the signal indicative of the rate of change of power distributed to the microprocessor.

2. The microelectronic power regulator of claim 1, wherein the sense circuit is configured to sense a rate of change of voltage distributed to the microprocessor.

3. The microelectronic power regulator of claim 1, wherein the sense circuit is configured to sense a rate of change of current distributed to the microprocessor.

4. The microelectronic power regulator of claim 3, wherein the sense circuit comprises an inductor, and the rate of change of current is determined by measuring a voltage drop across the inductor.

5. The microelectronic power regulator of claim 1, wherein the sense circuit includes an amplifier configured to transmit a signal to the first power regulator, the signal in proportion to the rate of change of power.

6. The microelectronic power regulator of claim 1, wherein the sense circuit comprises a comparator and wherein the sense circuit is configured to transmit a signal to the first power regulator after a predetermined rate of change of power distributed to the microprocessor is exceeded.

7. The microelectronic power regulator of claim 1, further comprising a second power regulator electrically coupled to the sense circuit.

8. A microelectronic power regulator system comprising:

a power source;

a first power regulator coupled to the power source and a load;

a second power regulator coupled to the load; and

a sense circuit coupled to the second power regulator, the sense circuit configured to detect a rate of change of power and send a signal to the second power regulator in response to the rate of change of power.

9. The microelectronic power regulator system of claim 8, wherein the sense circuit is further configured to send a signal to the first power regulator in response to the rate of change of power.

10. The microelectronic power regulator of claim 8, wherein the sense circuit is configured to sense a rate of change of voltage distributed to the microprocessor.

11. The microelectronic power regulator of claim 8, wherein the sense circuit is configured to sense a rate of change of current distributed to the microprocessor.

12. The microelectronic power regulator of claim 11, wherein the sense circuit comprises an inductor, and the rate of change of current is determined by measuring a voltage drop across the inductor.

13. A power regulator for responding to transient power demands, comprising:

a negative transient response portion configured to response to fast transient negative current events, the negative response portion comprising a sense circuit and a current source; and

a positive transient response portion configured to response to fast transient positive current events, the positive response portion comprising a sense circuit and a current sink.

14. The power regulator for responding to transient power demands of claim 13, wherein the negative transient response portion further comprises an output transistor configured to be in an on state when power is supplied to the negative transient response portion.

15. The power regulator for responding to transient power demands of claim 14, wherein the negative transient response portion further comprises a sense transistor coupled to a the current source and the output transistor, wherein quiescent current of the output transistor is less than the current supplied by the output transistor in response to a transient power demand.

16. The power regulator for responding to transient power demands of claim 15, wherein the negative transient response portion further comprises an amplifier coupled in series between the current source and the sense transistor, wherein the output transistor responds to transient events that are faster than the operating bandwidth of the amplifier.

17. The power regulator for responding to transient power demands of claim 15, wherein the sense transistor is a bipolar device.

18. The power regulator for responding to transient power demands of claim 15, wherein the sense transistor is a metal oxide semiconductor device.

19. The power regulator for responding to transient power demands of claim 14, wherein the output transistor is a bipolar device.

20. The power regulator for responding to transient power demands of claim 14, wherein the output transistor is a metal oxide semiconductor device.

21. The power regulator for responding to transient power demands of claim 13, wherein the positive transient response portion further comprises an output transistor configured to be in an on state when power is supplied to the positive transient response portion.

22. The power regulator for responding to transient power demands of claim 13, wherein the positive transient response portion further comprises a sense transistor coupled to a the current source and the output transistor, wherein quiescent current of the output transistor is less than the current supplied by the output transistor in response to a transient power demand.

23. The power regulator for responding to transient power demands of claim 22, wherein the positive transient response portion further comprises an amplifier coupled in series between the current source and the sense transistor, wherein the output transistor responds to transient events that are faster than the operating bandwidth of the amplifier.

24. The power regulator for responding to transient power demands of claim 22, wherein the sense transistor is a bipolar device.

25. The power regulator for responding to transient power demands of claim 22, wherein the sense transistor is a metal oxide semiconductor device.

26. The power regulator for responding to transient power demands of claim 21, wherein the sense transistor is a bipolar device.

27. The power regulator for responding to transient power demands of claim 21, wherein the sense transistor is a metal oxide semiconductor device.

28. The power regulator for responding to transient power demands of claim 21, wherein the current source comprises a resistor and a voltage source.

29. The power regulator for responding to transient power demands of claim 21, wherein the current sink comprises a resistor and a voltage source.

30. A power regulation system comprising the power regulator of claim 13.

31. The power regulation system of claim 30, further comprising a primary voltage regulator coupled in series to the power regulator, wherein the primary voltage regulator is configured to supply power to a load and respond to slow transient events, and wherein the power regulator is configured to respond to fast transient events.

32. The power regulation system of claim 31, wherein the power regulator is configured to respond to transient events that occur at a rate greater than about 10 Megahertz, and wherein the primary voltage regulator is configured to respond to transient events less than about 10 Megahertz.

33. A power regulation system for supplying power to a microelectronic device and for suppressing transient power demands, the system comprising:

a first voltage regulator configured to supply power to a load and to respond to slow transient power demands, the first voltage regulator including a first voltage output, a second voltage output, and a ground output; and

a second voltage regulator coupled to the second voltage output of the first voltage regulator, the second voltage regulator configured to respond to fast transient power demands, the second voltage regulator comprising a sense amplifier, a current source, and a current sink.

34. The power regulation system of claim 33, wherein a voltage at the second voltage output is greater than a voltage at the first voltage output.

35. The power regulation system of claim 33, further comprising a sense element configured to detect a rate of change of current and produce a signal proportional to the rate of change of current.

36. The power regulation system of claim 33, wherein the sense amplifier is coupled to the first voltage regulator.

37. The power regulation system of claim 33, further comprising a sense element configured to detect a rate of change of voltage and produce a signal proportional to the rate of change of voltage.

38. The power regulation system of claim 33, further comprising a plurality of charge sources configured to distribute power to a plurality of locations on a microprocessor.

39. The power regulation system of claim 33, wherein the second voltage regulator further comprises an amplifier coupled to the current source, a sense transistor coupled to an output of the amplifier, and an output transistor coupled to the sense transistor.

40. The power regulation system of claim 39, wherein the sense transistor is a bipolar device.

41. The power regulation system of claim 39, wherein the sense transistor is a metal oxide semiconductor device.

42. The power regulation system of claim 39, wherein the output transistor is a bipolar device.

43. The power regulation system of claim 39, wherein the output transistor is a metal oxide semiconductor device.

44. The power regulation system of claim 33, wherein the second voltage regulator is configured to respond to transient events that occur at a rate greater than about 10 Megahertz, and wherein the first voltage regulator is configured to respond to transient events less than about 10 Megahertz.

45. The power regulation system of claim 33, further comprising a sense element configured to receive a signal from a load, the signal indicative of power required by at least a portion of the load.

46. A microelectronic power regulator system comprising:

a power source;

a primary power regulator coupled to the power source;

a secondary power regulator coupled to the power source, the secondary regulator configured to respond to power demands at a higher frequency than the primary power regulator; and

a sense circuit coupled to the secondary power regulator, the sense circuit configured to detect a rate of change of power and send a signal to the secondary power regulator in response to the rate of change of power.

47. The microelectronic power regulator system of claim 46, wherein the secondary regulator is coupled in parallel to a load.

48. The microelectronic power regulator system of claim 46, wherein the secondary regulator is configured to be on when power is supplied to the primary regulator and is further configured to provide power to a load only when the primary regulator cannot sufficiently supply the power demanded by the load.

49. The microelectronic power regulator system of claim 46, wherein the primary regulator is coupled in series to a load.

50. The microelectronic power regulator system of claim 46, further comprising a plurality of secondary regulators, wherein each of said plurality of secondary regulators is configured to supply power to a portion of a load.

51. The microelectronic power regulator system of claim 46, wherein the sense circuit is configured to receive a signal from the load, the signal indicative of power required by at least a portion of the load.

52. A power regulator configured to respond to transient load events, the regulator comprising:

an amplifier including a transconductance stage and an output stage;

a compensation capacitor coupled to the output of the transconductance stage of the amplifier and further coupled to ground;

a sense circuit including a threshold voltage reference and a comparator coupled to the threshold voltage reference, the sense circuit coupled to the input of the transconductance stage of the amplifier and further coupled to a reference voltage source; and

a boost circuit coupled to the sense circuit, the boost circuit including a first switch coupled to a boost capacitor and further coupled to a voltage source, and a second switch coupled to the boost capacitor and the input of the output stage of the amplifier.

53. The power regulator configured to respond to transient load events of claim 52, further comprising an output transistor couple to the output of the output stage of the amplifier.

54. The power regulator configured to respond to transient load events of claim 53, further comprising a sense transistor electrically coupled to the output stage of the amplifier and further electrically coupled to the output transistor.